

[P.S.—Two points respecting the geographical distribution of the Gorilla appear to me to call for notice here. Last year (1898) the occurrence of a Gorilla near Brazzaville on the Congo was recorded, and, in fact, the specimen was brought to England. Secondly, in the same year was published Captain Burrows's book, entitled 'The Land of the Pigmies,' which contains a photograph of an Ape described as a Gorilla, which was shot at Stanley Falls. If we regard this Ape as a genuine Gorilla, it follows that the eastward range of that animal is much more extensive than it is commonly supposed to be; but unfortunately the evidence of the photograph alone does not support that specific title, showing as it does that the specimen was possessed of distinct Chimpanzee features. Without further investigation, therefore, no final conclusion on this point can be arrived at.]

3. On the Myology of the Edentata. By BERTRAM C. A. WINDLE, D.Sc., M.D., M.A., F.R.S., Professor of Anatomy in Mason University College, Birmingham, and F. G. PARSONS, F.R.C.S., F.Z.S., F.L.S., Lecturer on Comparative Anatomy at St. Thomas's Hospital and Hunterian Professor in the Royal College of Surgeons, England.

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Part I.—MUSCLES OF THE HEAD, NECK, AND FORE LIMB.

It has been for some time our intention to gather together the very scattered literature on the subject of Edentate myology, and to check it by a series of dissections of such animals as we could collect. We are greatly indebted to this Society, to Professor Stewart of the Royal College of Surgeons, and to Professor Howes of the Royal College of Science for giving us opportunities of dissecting specimens in their stores. We submit that the comparatively large number of records which we have been able to bring together as the result of our own dissections and a study of the literature has given us an opportunity of indicating which muscles are constant and which are liable to variation. For this reason we are glad to be able to point out that we have several records of most of the existing genera of Edentates. There are many points on which further information is desirable, and we feel that the paper is far from complete; still, as the investigation has been lengthy and arduous, it has seemed best to publish this first part and to defer, as in the case of the Carnivora, the generalizations which we intend to offer, until the remainder of the muscles are dealt with, in a second part of this paper. As in former papers, small numerals refer to the list of animals at the commencement of the paper and Roman figures to the bibliography at its end. Those animals in the list against which no author's name is placed have been dissected by ourselves.

List of Animals.

Family BRADYPODIDÆ.

1. *Bradypus tridactylus*.
2. " " (Humphry, IV.)
3. " " (Macalister, XIV.)
4. " " (Meckel, XI.)
5. " " (Mackintosh, XVI.)
6. " " (Cuvier & Laurillard, XVII.)
7. " " "
8. *Cholepus didactylus*.
9. " " (Humphry, IV.)
10. " " (Mackintosh, XIII.)

Family MYRMECOPHAGIDÆ.

11. *Myrmecophaga jubata* ¹.
12. " " (Pouchet, II.)
13. " " (Macalister, I.)
14. *Tamandua tetradactyla*.
15. " " (Rapp, III.)
16. " " (Cuvier & Laurillard, XVII.)
17. *Cyclothurus didactylus*. (Humphry, IV.)
18. " " (Macalister, I.)
19. " " (Meckel, V.)
20. " " (Galton, VI.)
21. " " (Cuvier & Laurillard, XVII.)

Family DASYPODIDÆ.

22. *Dasypus villosus*.
23. " *sexcinctus*. (Galton, X.)
24. " " (Cuvier & Laurillard, XVII.)
25. *Tatusia peba*. (Macalister, VII.)
26. " sp. inc. (Meckel, XI.)
27. *Chlamydophorus truncatus*. (Macalister, XI.)
28. " " (Hyrtl, XII.)

Family MANIDÆ.

29. *Manis macrura*.
30. " "
31. " sp. inc.
32. " *aurita*. (Humphry, IV.)
33. " *tricuspis*. (Macalister, I.)
34. " *javanica*. (Macalister, VII.)

Family ORYCTEROPODIDÆ.

35. *Orycteropus capensis*. (Galton, VIII.)
36. " " (Humphry, IX.)
37. " " (Cuvier & Laurillard, XVII.)

¹ R.C.S. Eng. Collection.

Panniculus.—Bradypodidæ. The three records which we have of this muscle in *Bradypus* all agree in stating that the dorsal portion is very feebly marked. The ventral part or abdomino-humeralis passes backwards as far as the outer surface of the thigh, whilst anteriorly it covers in the axilla, and is attached to the pectoral ridge deep to the pectoral muscle. We have succeeded in satisfying ourselves that the sterno-facialis and sphincter colli are both absent in this family.

Myrmecophagidæ. In *Cyclothurus* the abdomino-humeralis resembles that of the *Bradypodidæ*; it is well marked on the outer side of the thigh and extends as far as the knee. Humphry (17) describes a femoral attachment between the ectoglutens and vastus externus. In *Tamandua* (14) the dorso-humeralis is better developed than the abdomino-humeralis.

Dasyppodidæ. In this family the panniculus is remarkably specialized, being divided into a number of slips which are inserted into the carapace. In *Tatusia peba* (25), Macalister describes seven parts, viz.: (a) abdomino-femoral, from the mid-line of the abdomen to the anterior edge of the femur; (b) abdomino-tergal, from the anterior part of the mid-line of the abdomen to the deep surface of the dorsal shield; (c) ischio-tergal, from the tuber ischii to the deep surface of the pelvic shield; (d) pectoro-brachial, from the mid-line of the pectoral region to the fascia on the inner border of the arm; (e) dorso-pectoral, from the integument over the clavicular pectoral to the anterior angle of the dorsal shield; (f) from the angle of the mouth and the skin over the side of the jaw to the lateral border of the dorsal shield as far as the elbow; (g) a similar and longer slip connected with the posterior trapezius. In *Dasyppus villosus* (22) the most important bundle, which is probably platysmal in its nature, passes from the lower part of the zygorama to the cephalic border of the first part of the dorsal carapace and thence backwards as far as the fourth segment. Another band passes from the skull above the orbit to the head-shield. In *Dasyppus sexcinctus* (24), Cuvier and Laurillard figure these zygomatic and occipital bundles, the former being, as in *villosus*, much the larger of the two. The acromio-basilar of Galton (23) is well-marked and passes from the skull anterior and lateral to the occipital slip to the acromion process at its junction with the spine. It lies wholly superficial to the trapezius, and is clearly the same as Cuvier's portion cervicale du trapèze.

In *Chlamydephorus* (27) there is no connection between the panniculus and the sphæroma; the abdomino-humeralis is represented by a thin slip from the external aspect of the thigh to the surface of the abdomen. Some fibres, which appear to be quite separate from those of the trapezius, pass from over the scapula to the cephalic shield, and these may probably be homologous with the acromio-basilar of *Dasyppus*. In the *Manidæ* the panniculus more closely resembles the more common mammalian arrangement. The abdomino-humeralis is very thick and dorsally inseparable from the dorso-humeralis, the two covering the outer side and

front of the thigh and buttocks. Some fibres also find their way to the inner side of the thigh and there blend with the gracilis. Anteriorly the more ventral fibres, to which alone the name of abdomino-humeralis should be applied, pass deep to the pectorals and are inserted partly into the ribs and partly into the pectoral ridge of the humerus. The more dorsal part of the pannicular sheet, or dorso-humeralis, is partly inserted with the abdomino-humeralis, deep to the pectorals, and partly runs to the fascia of the dorsal surface of the arm and the posterior border of the outer end of the spine of the scapula. In our specimens of *Manis* the platysma is quite rudimentary, though it appears to be well developed in *Manis javanica* (34) (Macalister). In the *Orycteropodidae* (35, 36) there seems to be a remarkably well-developed panniculus. We have not, unfortunately, had the opportunity ourselves of dissecting the Aardvark, but the descriptions of the platysma in this animal which are at our disposal are quite clear, and seem to show that it there reaches a development superior to anything which we have as yet met with in our researches into mammalian musculature. It is described as passing from the zygomatic region over the neck and shoulder and arm to the radial side of the forearm. Humphry (36) and Cuvier and Laurillard (37) both figure this extensive platysma, and both also figure a very well-marked sphincter colli or sterno-facialis running backwards to the hinder end of the sternum, superficial to the pectorals. Galton (35) describes a muscle running from the orbicularis oris to the hinder end of the thorax, where it is attached to the mid-line of the sternum: this, there can be little doubt, is the sterno-facialis (cf. "Lectures on the Muscles of Mammals," Journ. of Anat. & Phys. vol. xxxii. p. 430). The same author states that part of this muscle passes under the jaw and round the neck, a fasciculus which quite clearly corresponds to the sphincter colli of other mammals. The abdomino-humeral part of the panniculus in this animal is also well developed (37).

Facial Muscles.—There is little of special interest to note with regard to the facial muscles of the Edentates, and there is so much variety in the terminology employed by different writers that a satisfactory generalization is most difficult. All the animals seem to possess the orbiculares palpebrarum et oris, levator labii superioris, zygomaticus, depressor labii inferioris, and retractor naris, as well as anterior, superior, and posterior auricular muscles, the last-mentioned being usually the best developed of the three. The muscles of the face in *Myrmecophaga* have been described in great detail by Owen (Trans. Zool. Soc. vol. iv.).

In *Bradypus* the zygomaticus is well marked, whilst the most remarkable feature in the *Dasypodidae* and *Manidae* is the great development of the retractor naris, which rises from the zygoma and passes directly forwards to the snout and is evidently a valuable adjunct in rooting and grubbing.

Masseter.—In *Bradypus* (1) the muscle is bilaminar, but the two layers are not very easily separable. The superficial rises

from the anterior inferior border and from the inferior angle of the malar, and is inserted into the lower border of the mandible from the angle to midway between the angle and the symphysis. The deep layer comes from the lower part of the posterior border of the malar and is inserted into the outer surface of the mandibular ramus. In his elaborate account of the muscles of the face in *Myrmecophaga*, Owen does not mention any bilamination of the masseter. In *Dasypus* (22) the muscle is distinctly bilaminar. The same condition obtains also in *Chlamydophorus* (27, 28), where, according to Hyrtl, it is intersected by tendons. In *Manis* (29, 30) the masseter is thin and unilaminar and arises from a fibrous zygoma. We have no records of its condition in *Orycteropus*.

Temporal, *Buccinator*, and *Pterygoidei* show no points of special interest.

Digastric.—In the *Bradypodidæ* this muscle reaches from the paramastoid process to the middle third of the body of the mandible. In 1, 5, and 6 it is described as possessing a slight tendinous intersection opposite the hyoid bone, from the inner side of which intersection is given off a fibrous arcade similar to that met with amongst the *Sciuridæ*. In 3 no tendinous intersection was noticed. *Choloepus* (9) has a tendinous intersection, though none was noticed by Macalister in his specimen. We have no records of the digastric in any of the *Myrmecophagidæ*. Among the *Dasypodidæ* the digastric is described as monogastric by Macalister, who states that it is attached below the mandible in *Dasypus* and *Tatusia*. In our specimen of *Dasypus*, and in a second which we specially examined with reference to this point, the muscle was absent, but it is figured by Cuvier and Laurillard (24) as arising by tendon and inserted by fleshy fibres. In *Chlamydophorus*, Macalister found a very small digastric passing from the bulla tympani to the mandible, but Hyrtl found none in his specimen of the same animal. In the *Manidæ* the digastric is inserted into the lower jaw as far as halfway to the symphysis; it possesses no central tendon (29). In the *Orycteropodidæ* (36, 37) the muscle has the same arrangement.

Mylo-hyoid.—This muscle is always well marked in the Edentates, being especially large in *Myrmecophaga*, *Tamandua*, and *Manis*, in all of which animals the posterior fibres curve round the sterno-glossi and the part of the tongue into which these are inserted, forming a narrow tunnel or sheath in which they are enclosed.

Sterno-maxillaris, *Hyoid*, and *Thyroid*.—The first of these muscles is absent in the *Bradypodidæ*. In *Bradypus* (1, 5) the latter two are fused as far as the caudal edge of the larynx, at which point a slip is delaminated from the mesial and ventral part of the muscle and continued to the hyoid bone, the greater part of the muscle passing to the thyroid cartilage. In *Choloepus* (10) the two muscles have practically the human attachments. In the *Myrmecophagidæ* the sterno-maxillaris is present as a superficial

delamination from the sterno-hyoid (*M. jubata*, Owen, XV.). In *Tamandua* and *Cyclothurus* it rises from the manubrium and is inserted into the mandible near the symphysis. In the *Dasypodidae* the sterno-maxillaris is also present in *Dasypus* (22), *Tatusia* (25), and *Chlamydophorus* (27, 28). In the *Manidae* no sterno-maxillaris was noticed nor is any recorded in *Orycteropus*. The only animal in which a tendinous intersection was noticed was *Tamandua* (14), in which the condition existed in the sterno-maxillaris.

Sterno-glossus.—This muscle has so far only been recorded in *Myrmecophaga*, *Tamandua*, and *Manis*. Whether it is present in *Cyclothurus* we are unable to state. It rises from the xiphisternum and the last one or two true ribs and passes forward at first deep to the sternum and costal cartilages, and is subsequently ensheathed, as has already been mentioned, in fibres derived from the mylo-hyoid, to be inserted into the tongue. In *Myrmecophaga* Owen points out that it is intersected in its thoracic portion by lineæ transversæ.

Styloid Muscles.—The stylo-hyoid, glossus, and pharyngeus seem to be generally present, and of these the stylo-glossus appears to be always the best developed. The stylo-pharyngeus is usually small, and the stylo-hyoid is sometimes absent.

Omo-hyoid.—In no Edentate have we ever seen this muscle, nor is it specifically described by any author, though it is stated in one paper that Cuvier noted it in *Myrmecophaga*, a reference which we have been unable to trace.

Sterno-cleido-mastoid.—In the *Bradypodidae*, *Bradypus* (1, 3, 4) is remarkable for having the two parts closely united, whilst in *Choloepus* they are distinct. In *Bradypus* the single muscle rises from the manubrium and the fascia external to it and may (3) get a slight origin from the rudimentary clavicle. It is inserted into the paramastoid and paroccipital region of the skull and has the spinal accessory nerve on its deep surface. In *Choloepus* both sterno- and cleido-mastoids are present, the latter coming from the middle third of the clavicle, and the spinal accessory nerve passes between them. The cleido-mastoid muscle when it is present is, as in most mammals, inserted deep to the sterno-mastoid. In the *Myrmecophagidae*, *Myrmecophaga* and *Tamandua* have only a sterno-mastoid, but *Cyclothurus*, in which the clavicle is well developed, has both sterno- and cleido-mastoids (17, 21). In one specimen of this animal (19) there are described distinct sterno-mastoid, cleido-occipital, and cleido-mastoid, the latter lying deep to the cleido-occipital. It is to be regretted that the relation of the spinal accessory nerve to these three muscles is not recorded. In the *Dasypodidae*, *Dasypus* (22, 23, 24), *Tatusia* (25, 26), and *Chlamydophorus* (27) have separate sterno- and cleido-mastoids. In the last-mentioned animal, Hyrtl (28) mentions that the sterno-mastoids of opposite sides are fused in the neck. In *Manis* (29) the cleido-mastoid is absent. In *Orycteropus* (35, 36, 37) both sterno- and cleido-mastoids are

present, and the latter arises from the inner $\frac{1}{2}$ or $\frac{1}{3}$ of the clavicle.

Omo-trachealian.—This muscle is not a constant feature in Edentate myology. When present, it arises, as is usually the case amongst mammals, from the transverse process of the atlas, and is inserted into the acromion process. In the *Bradypodidae* it was present in *Bradypus* (1, 3), being inserted in the latter specimen into the upper angle of the scapula. In another specimen (5) its existence is not mentioned, nor has it been noticed in *Choloæpus*. In the *Myrmecophagidae* the muscle was absent in *Myrmecophaga* (13), but present and well marked in *Tamandua* (16) and *Cyclothurus* (18, 19). In the *Dasypodidae* the muscle was absent in two specimens of *Dasypus* (22, 24) and no mention is made of its presence in a third (23); Macalister, however, records its existence in a specimen. In the *Manidae* the muscle is well marked, but shifts its anterior attachment from the atlas to the mastoid region of the skull (29, 30, 31, 32).

Scaleni.—In no Edentate have we seen or met with any record of a scalene muscle lying on the ventral aspect of the subclavian vessels, so that it may be fairly definitely laid down that the scalenus ventralis is a muscle totally wanting in this order. The scalenus longus is attached to a very small number of ribs, another characteristic feature of Edentate myology. The following table gives a list of the attachments of longus and brevis in several specimens:—

	Longus.	Brevis.
<i>Bradypus</i> (1)	6, 7, 8, 9 C. V. & rib i.	6, 7, 8, 9 C. V. & rib i.
" (4)	" " " " "	" " " " "
<i>Choloæpus</i> (10).....	2, 3, 4, 5, 6 C. V. & ribs i., ii.	
<i>Tamandua</i> (14)	3, 4, 5, 6 C. V. & rib i.	4, 5, 6, 7 C. V. & rib i.
<i>Cyclothurus</i> (17, 21) ...	4, 5, 6, 7 C. V. & rib i.	
<i>Dasypus</i> (22)	ribs iii., iv., v.	ribs ii., iii., iv.
<i>Tatusia</i> (25)	ribs i., ii., iii.	ribs i., ii.
<i>Chlamydomorphus</i> (27)...	2, 3, 4, 5, 6 C. V. & rib ii.	2, 3, 4, 5, 6 C. V. & rib i.
" (28)...	" " " " "	" " " " "
<i>Manis</i> (29)	2, 3, 4, C. V. & ribs ii., iii., iv.	4, 5, C. V. & rib i.

Rectus thoracis lateralis.—This muscle is, so far as we know, characteristic of the Edentates, as we have neither met with it nor any description of it among other mammals, in the course of our researches. It continues the direction of the scalenus longus caudalwards, being attached anteriorly to the first rib or pair of ribs and posteriorly to some of the hinder ribs. As a rule, the muscle is external to the rectus ventralis, but when the two overlap, as they did in our specimen of *Dasypus* (22), the rectus ventralis is the more superficial of the two, a fact which shows that the rectus thoracis lateralis cannot be regarded as a displaced supra-costalis. Indeed, the fact that it is found in *Choloæpus* (10) co-existing with the supra-costalis is alone sufficient to prove this. Macalister considers that this muscle is a lateral displace-

ment of a portion of the rectus ventralis. We have, however, very carefully examined the question and have come to the conclusion, from the facts that (i.) it so often continues the direction of the scaleni and (ii.) is occasionally connected to them by direct fibres, that the muscle should be looked upon as a caudad extension of scalenus longus and that its presence is correlated with the fact, already insisted upon, that the last-named muscle has a very limited attachment in the costal region. In the *Bradypodidæ* the muscle was noticed in five specimens of *Bradypus* (1, 3, 4, 5, 6); it was attached in all to the first rib anteriorly, but its posterior connections were various. In *Choloepus* (10) it passed from the first and second ribs to the eighth and ninth. Amongst the *Myrmecophagidæ*, we have no record of its occurrence in *Myrmecophaga* itself, but in *Tamandua* (14, 16) it is well marked and passes from the first to the seventh and eighth ribs; it was also present in four specimens of *Cyclothurus* (17, 19, 20, 21). In the *Dasypodidæ* the muscle, for some reason not apparent to us, shifts its anterior attachment nearer to the mid-ventral line. Thus in *Dasypus* (22), as we have already mentioned, it is attached deep to the rectus ventralis, whilst in *Tatusia* (25) its anterior attachment is to the manubrium sterni. In *Chlamydophorus* (27) the muscle is very slender and feeble and is attached to the first rib. In another specimen of the same animal (28) Hyrtl does not allude to the muscle. Amongst the *Manidæ* the muscle was found passing from the 1st to the 3rd, 4th, 5th, 6th, and 7th ribs in *Manis* (29). Its presence is not recorded in any of the descriptions of the *Orycteropodidæ*, nor do Cuvier and Laurillard figure it in their plates of the myology of this animal (37).

Recti capitis dorsales.—There does not seem to be any delamination, producing a r. c. d. medius, as is the case in so many mammals. We find only records of r. c. d. superficialis et profundus (r. c. posticus major and minor), as in Man.

Splenius capitis et colli.—These muscles are subject to a good deal of variation in the Edentata and especially amongst the *Bradypodidæ*. In *Bradypus*, a form possessing nine cervical vertebræ, we are not surprised to find the colli very large and the capitis either very small (1, 4, 6) or absent altogether (3). In one specimen (3) there were two splenii colli, the anterior arising from the spines of the 3rd, 4th, 5th, and 6th cervical vertebræ, while the posterior came from five spines behind these. In *Choloepus* (10), a form in which the number of cervical vertebræ is liable to reduction, the splenius capitis was large and rose from all the cervical spines or the ligamentum nuchæ dorsal to them. The splenius colli was absent. Amongst the *Myrmecophagidæ* there was no splenius colli in *Tamandua* (14) or *Cyclothurus* (21). In another specimen of the first-named animal (16) it went to the atlas only. Amongst the *Dasypodidæ* there was no splenius colli in *Dasypus* (22, 24), *Tatusia* (25), or *Chlamydophorus* (27). In *Manis* (29) there is also no splenius colli, nor have we any record of the muscle in *Orycteropus*. We may sum up the description of

these muscles amongst the Edentates by saying that the splenius colli is usually absent throughout the Order with the exception of *Bradypus*, in which animal the splenius capitis is feeble or wanting.

Trapezius.—In *Bradypus* (1, 2, 3, 5, 6) this muscle fails to reach the occiput, a fact which seems to be correlated with the lengthening of the neck due to the two extra cervical vertebræ. The origin is from the ligamentum nuchæ and the anterior 4th, 5th, and 6th spines. The anterior cervical fibres are continuous with the clavicular deltoid to form a cephalo-humeralis; the posterior cervical and thoracic fibres are separated from the former by a fibrous interval and are inserted into the spine of the scapula and acromion process. In *Choloepus* the anterior part rises from the occiput and ligamentum nuchæ, and is inserted into the lower border of the scapular spine. The posterior fibres can with difficulty be separated from these and are inserted into the whole length of the spine. In the *Myrmecophagidæ* the trapezius forms a continuous sheet. In *Myrmecophaga* (13), *Tamandua* (14, 16), and two specimens of *Cyclothurus* (17, 21) there was no occipital origin, but in other specimens of the last-named animal (18, 19, 20) the muscle rose from the occipital curved line. In *Cyclothurus* the anterior fibres are inserted into the outer part of the clavicle, which is well developed in this animal. In *Myrmecophaga* (11) and *Tamandua* (14, 16) the anterior fibres form with the clavicular deltoid a well-developed cephalo-humeral, and as usual there is a fibrous intersection in the position of the clavicle. Amongst the *Dasypodidæ*, *Dasypus* (22) has the anterior fibres of the trapezius arising from the deep surface of the anterior part of the carapace, and these fibres form the cephalo-humeral. The posterior part of the muscle rises from the fourth cervical to the last thoracic spines and is inserted into the scapular spine. In *Chlamydomorphus* the anterior part of the muscle is separated from the posterior by a cellular interval, the anterior fibres, as in *Dasypus*, arising from the head-shield. In *Tatusia* no mention is made of an origin from the carapace. In the *Manidæ* the cephalo-humeral is well marked and rises from the occiput (29, 31, 32, 33, 34). The remainder of the muscle forms one mass and is inserted into the spine of the scapula and its acromion process. In *Orycteropus* (35, 36, 37) the origin is from the occiput, ligamentum nuchæ, and anterior nine or ten thoracic spines, the insertion is into the spine and acromion process of the scapula, but there is apparently no clavicular bundle or cephalo-humeral muscle.

Latissimus dorsi.—This muscle has the ordinary origin from the posterior half of the thoracic spines, the lumbar fascia, and three or four posterior ribs, and is inserted, as usual in mammals, into the humerus below its neck. In the *Dasypodidæ* it is remarkable for rising from more ribs than usual, often from the third or fourth to the last. These costal origins blend with the deep part of the insertion of the pectorals, and form a muscular floor to the axilla. We regard them as unusually well-developed achselbogen,

or portions of the pectoral mass. Regarding as we do this mass and the panniculus of the region as portions of the differentiated lateral sheet of muscle carried out by the limb-bud, we believe achselbogen to be a rudimentary condition represented in its fullest development by the presence of a muscular floor to the axilla, and that in both these conditions we have to do with a section of the sheet lying between the pectorals and the latissimus dorsi. This arrangement has been noticed in *Dasyppus* (22, 23, 24), *Tatusia* (25, 26), and *Chlamydochorus* (27, 28). In the last-named animal Macalister describes a special bundle of fibres rising from the mammillary processes of the first two lumbar vertebrae and gaining insertion into the posterior inferior angle of the scapula. We can quite concur with his statement that this bundle is not found in any other Edentate.

Latissimo-olecranalis.—This muscle is always present in Edentates, and is singularly well developed in many of them. In the *Bradypodidae* the muscle is not of great size; in *Bradypus* it is inserted into the internal supra-condylar ridge (1, 2, 4, 6), while in *Choloepus* it is attached to the arch of the large supra-condylar foramen. In the *Myrmecophagidae* the muscle is of fair size and (in the specimen O. 11 at the R. C. S.) attached to the inner side of the olecranon. Pouchet (II.) speaks of an "accessoire interne" arising from the infraspinous fossa in his specimen (12). This may be a displaced latissimo-olecranalis, though the condition is clearly abnormal, since it was neither found by Macalister nor by ourselves (11). In *Tamandua* (14) we found the muscle with its usual attachments; but Rapp (III.) found it rising from the scapula close to the teres major, a condition which nearly agrees with that described by Pouchet as the "accessoire interne." In *Cyclothurus* the muscle has a more extended insertion than in the other Ant-eaters; it is attached to the forearm from the olecranon process to the palmar fascia (17, 18, 19, 20). Humphry (IV.) says that from its insertion the palmaris longus takes origin, this being one of several instances of unusual continuity between muscles generally separate one from another in other Orders. In the *Dasyppodidae* the muscle is very large and often has further origins than that which it obtains from the latissimus dorsi. In *Dasyppus* (22) we found it rising (a) from the main insertion of the latissimus dorsi, (b) from the dorsum scapulae, and (c) from that part of the latissimus dorsi muscle which arises from the thoracic vertebrae. The muscle covered the dorsal and internal aspects of the arm and was folded round the triceps in such a way as to render that muscle invisible until the latissimo-olecranalis was removed. The insertion was into the olecranon and upper half of the subcutaneous margin of the ulna. This is the maximum development of the muscle so far met with by us in any mammal. Galton does not mention any independent origin from the scapula in this animal (23), but otherwise his description agrees with our own. Cuvier and Laurillard (24) figure the same extensive insertion. In *Tatusia* the muscle is very large, and in one specimen (25) obtains an extra

origin from the *teres major*. In *Chlamydochorus* (27) it is also large and is inserted into the internal condyle, internal lateral ligament, olecranon, and fascia of the forearm. In the *Manidae* the muscle is not quite so well developed as in the *Armadillos*; in this class it is inserted into the olecranon and fascia of the forearm (29, 30, 31, 32, 33). In *Orycteropus* (35) the muscle rises from the *latissimus dorsi* and apparently gets additional slips from the scapula and *teres major*; in part it joins the long head of the *triceps*.

Rhomboidei.—We have found it convenient for the purposes of mammalian myology to describe the rhomboid sheet in two parts, viz. *rhomboideus capitis et colli* and *rhomboideus thoracis*. In the *Bradypodidae* the rule holds good which we have already found to apply to other neck-muscles. In correlation with its additional cervical vertebræ, *Bradypus* (1, 3, 4, 5) has no occipital origin to the rhomboid, whilst in *Choloepus* this origin is well marked. In *Bradypus* there is no division between the *rhomboidei colli et thoracis*, but in *Choloepus* (8) the *r. thoracis*, which is inserted into the vertebral border of the scapula opposite the root of the spine, is, at its origin, deep to the *rhomboideus capitis et colli*. In the *Myrmecophagidae* the muscle forms a single undivided sheet without any occipital origin in *Myrmecophaga* (13), *Tamandua* (14, 16), or *Cyclothurus* (18, 19, 20). In the *Dasypodidae* an occipital origin is always present and the *rhomboideus thoracis* is usually separate from the *rhomboideus capitis et colli*. The *rhomboideus capitis* often forms a separate slip and is called by Galton (VI.) the *occipito-scapular*. In the *Manidae* the occipital origin is also always present (29, 31, 33, 34). In the *Orycteropidae* the occipital origin is present but ill-developed (35, 36).

Rhomboideus profundus (Levator scapulae minor).—This muscle, which rises from the transverse process of the atlas and is inserted into the base of the spine of the scapula, seems only to be distinct in *Orycteropus* (35, 36, 37). Indications of it may be found in other animals, but in them it is usually more or less blended with adjacent muscles, such as the *rhomboideus capitis et colli*, *omotrachelian*, or *serratus ventralis colli* (neck portion of *serratus magnus*).

Serratus ventralis colli et thoracis (Serratus magnus).—The following origins of this muscle are given by different observers:—

	Cerv. Tr. Procs.	Ribs.
<i>Bradypus</i> (1)	absent.	1-7
" (2)	6-9	1-2
" (3)	6-9	1-8
" (4)	9	1-7
" (5)	7-9	1-7
" (6)	9	1-7
<i>Choloepus</i> (10)	5-7	1-8
<i>Myrmecophaga</i> (13)	2-7	1-8
<i>Tamandua</i> (14)	1-7	1-7

	Cerv. Tr. Procs.	Ribs.
<i>Cyclothurus</i> (17)	2-7	1-8
" (18)	5-7	1-7
" (20)	5-7	1-7
" (21)	5-7	1-7
<i>Dasypus</i> (22)	hinder C. V.	1-8 or 9
" (24)	5-7	1-7
<i>Manis</i> (29)	1-7	1-7
" (30)	1-7	1-7
" (32)	2-7	-
" (33)	2-7	1-6
<i>Orycteropus</i> (35)	2-7	1-8
" (36)	2-7	1-8
" (37)	2-7	1-8

From the foregoing it will be seen that the neck portion of the muscle (the levator anguli scapulæ of human myology) is either absent or feebly developed in the *Bradypodidæ*. In *Tamandua* (14) and two specimens of *Manis* (29, 30) it is described as arising from the atlas, but past experience makes us think that in these cases the rhomboideus profundus is incorporated with the serratus ventralis colli. In some cases, e. g. *Cyclothurus*, the cervical, anterior and posterior thoracic origins may remain distinct as far as their insertion, and the muscle may then consist of three portions, as it more or less does in Man. In other cases, e. g. *Dasypus* (22), the cervical and thoracic portions may form two separate sheets, while in many instances the whole muscle forms one continuous plane. It may be added that on the whole the muscle is one of great strength, exceeding in this respect the condition met with in most of the mammals examined by us, also that the scapular insertion often takes the form of two strong bundles attached to a triangular portion of bone at the caudal and cephalic ends of the scapula respectively, the part between, though continuous with these two bundles, being comparatively thin.

Pectorales.—The pectoral mass in Edentates, as, indeed, generally amongst the Mammalia, is exceedingly hard to classify, for the greater the amount of available material, the more difficult does the generalization become. We feel that the only way to do justice to the subject would be to repeat the various descriptions *in extenso*; but as this is hardly possible, we shall content ourselves with making what generalization we can. We believe that a typical pectoral has superficial and deep manubrial and superficial and deep gladiolar planes, that there may be a clavicular portion and an abdominal sheet or pectoralis quartus arising from the linea alba, that one or more bundles may rise from the anterior ribs deep to the gladiolar fibres, and that these may be described as a pectoralis minor. In *Bradypus* we have six descriptions, no two of which agree. Macalister and Mackintosh failed to find any abdominal portion or anything representing a pectoralis minor.

In our specimens (1, 7) we found a feeble pectoralis minor rising from the second costal cartilage and passing to the fascia over the shoulder; while the abdominal pectoral (pectoralis quartus) was present and closely blended with the abdomino-humeral part of the panniculus. Cuvier and Laurillard (6) show in their figure an absence of pectoralis quartus, thus agreeing with Macalister and Mackintosh, but they represent a fairly well-marked pectoralis minor.

In *Cholæpus* a special bundle corresponding in origin to the superficial gladiolar fibres was inserted into the inner border of the flexor surface of the forearm. In *Myrmecophaga* (13) the superficial and deep manubrial fibres were fused and the superficial and deep gladiolar were distinct. There was no pectoralis minor. In *Tamandua* (14) and *Cyclothurus* (17, 18) the superficial manubrial and gladiolar fibres were fused. In *Dasypus* (22, 24) the same condition obtains, but the place of the deep gladiolar fibres is taken by the large part of the latissimus dorsi which passes across the floor of the axilla and is inserted with the pectorals. In *Tatusia* (25) clavicular, sternal, and abdominal bundles are present, and the same description applies to *Chlamydophorus* (27). In *Manis* (29, 30, 32) the superficial manubrial bundle is well marked, and, although narrow at its origin, spreads out to be inserted from the lower end of the deltoid tubercle to the internal condyle. In one specimen (30) it is noted that these manubrial fibres are twisted upon themselves in such a way that those rising most deeply were most superficial at their insertion. In *Orycteropus*, Macalister (I.), Humphry (IX.), and Galton (VIII.) all agree that a pectoralis minor is present. The pectoralis quartus (37) is also well marked.

Subclavius.—This muscle in the Edentates varies a good deal and is of considerable interest. In the *Bradypodidæ* it is present and is inserted not only into the clavicle, but into the coracoid process and acromion. This was the case in six specimens of this animal (2, 3, 4, 5, 6, 7) and in two of *Cholæpus* (10 and a specimen of Galton's). In the *Myrmecophagidæ* the muscle is absent not only in *Myrmecophaga* (13) and *Tamandua* (14 and X. p. 528), which have only rudimentary clavicles, but also in *Cyclothurus* (17, 18, 20, 21), in which this bone is well developed. In the *Dasypodidæ* the muscle is always large and inserted chiefly into the acromion process and the fascia over the supraspinatus. This is true of *Dasypus* (22, 23), *Tatusia* (25), and *Chlamydophorus* (27, 28). In the *Manidæ* the muscle is wanting (29, 31, 32, 33, 34). In the *Orycteropodidæ* the subclavius is present (35, 36), but, as in most Edentates, is inserted more into the acromion and fascia over the supraspinatus than into the clavicle. This arrangement is clearly an approach to the sterno-scapularis muscle so constantly found amongst hystricomorphine rodents.

Deltoid.—The usual three parts of the deltoid are present in Edentates, and, as a rule, are inserted very close together into the deltoid ridge. Speaking generally, the usual mammalian rule is borne out, that clavicular fibres are inserted lowest and pass

superficially to the others, while the spinous fibres are inserted highest and pass deep to the other two bundles. In those animals in which the clavicle is absent or rudimentary, the clavicular part of the muscle is continuous with the ventral fibres of the trapezius to form a cephalo-humeral. Among the *Bradypodidae*, *Bradypus* has the cephalo-humeral, acromial, and spinous parts closely blended and inserted into the middle of the humerus (1, 3, 4). In two specimens (4, 5) a slip was given to the short head of the biceps from the cephalo-humeral. In *Choloepus* the insertion varied in two specimens—in one (10) the clavicular and acromial portions were both inserted into the radius, while in another (8) all three parts went to the deltoid tubercle. Among the *Myrmecophagidae*, *Myrmecophaga* (11, 12, 13) and *Tamandua* (14, 16) have each a cephalo-humeral and all three parts are inserted into the middle of the humerus. In *Cyclothurus* (17, 18, 19, 21) the clavicular, spinous, and acromial parts are all inserted into the humerus together, the two latter being apparently closely fused. In the *Dasypodidae* the clavicular slip rises from the clavicle in *Dasyppus* (22, 23), *Tatusia* (25, 26), and *Chlamydochorus* (27, 28), and is always inserted into the deltoid tubercle on the humerus. The acromial and spinous parts may or may not be separate. In the *Manidae* the cephalo-humeral is well marked, the spinous and acromial parts are more or less fused, and in several specimens (29, 32, 33, 34) a separate bundle was traced from the spine of the scapula to the triceps or supinator longus. Macalister expresses some doubt as to the nature of this slip; but we have been able to satisfy ourselves, by tracing the circumflex nerve into it, that it is a part of the deltoid. In the *Orycteropodidae* the clavicular portion is inserted into the radius with the biceps, the other two parts passing to the deltoid ridge (35, 36, 37).

Supra- and Infraspinati.—In all cases the supra- is considerably larger than the infraspinatus. In *Dasyppus* (22, 23) the latter muscle rises between the two scapular spines.

Teretes major et minor.—One of the great characteristics of all members of the Edentate Order, with the sole exception of the *Myrmecophagidae*, is the great development of the teres major. In many of these animals there is a considerable ridge of bone marking off the origin of the teretes from that of the infraspinatus. Of this ridge, which is called the inferior scapular spine, we have already written in connection with *Dasyppus*. The teres minor in most of the Order has been described as present. In some cases it is described as being fused with the infraspinatus or subscapularis, but from our own experience of the Order we can quite easily understand how two observers, in the instances in which the muscle is not well marked, might readily differ in their description of the same animal, so that we shall content ourselves by saying that this muscle is usually a distinct entity throughout the Edentata.

Subscapularis.—In the *Bradypodidae* the bundle of fibres rising from the axillary border of the scapula and obtaining an insertion

below the lesser tuberosity of the humerus is specially marked off from the rest of the muscle. The name of subscapulo-humeral, which sufficiently indicates its nature, has been suggested for this slip (1, 2, 5, 10). In one specimen of *Bradypus* (2) the subscapularis was divided into three parts, the hindmost of which was the subscapulo-humeralis. In *Myrmecophaga* Macalister (I.) found the muscle intersected by ten tendinous planes, and the specimen now in the R.C.S. Museum (11) shows the same condition. We further found in this specimen that five separate nerves, all from the dorsal part of the brachial plexus, entered the muscle. Macalister states that there are two accessory slips to the muscle in this animal: (a) the subscapulo-humeralis, and (b) "a triangular slip from the fossa above the subscapular nerve." Pouchet (II.) found that the tendon of insertion split into upper and lower parts and between them was the short head of the biceps; it is, however, just possible that he may have mistaken the upper edge of the supraspinatus, which is very prominent in this animal, for part of the insertion of the subscapularis. In *Tamandua* (14) the muscle is also considerably broken up. In no other Edentate was any special feature of interest noted in connection with this muscle.

Coraco-brachialis.—An Edentate characteristic of considerable interest is the great frequency of occurrence of the coraco-brachialis longus throughout the Order. In the *Bradypodidae*, *Bradypus* and *Choloepus*, as is so often the case, differ in their myology. In the former the coraco-brachialis medius alone is present (1, 2, 3, 4, 5, 6), and in our own specimen (1) we were careful to notice that the musculo-cutaneous nerve passed above the muscle, *i. e.* between it and the bone. In *Choloepus* (8, 10) the brevis and longus alone were present, though Galton (X.) in another specimen says that he found only a thin cord-like middle variety. In the *Myrmecophagidae*, *Myrmecophaga* (11, 12) and *Tamandua* (14, 15, 16) have the longus only attached to the supracondylar arch, and given off from the short head of the biceps of the middle of the arm; whilst in the four specimens of *Cyclothurus* of which we have records (17, 18, 20, 21) no coraco-brachialis at all was present. In the *Dasypodidae* the longus and brevis were present in two specimens of *Dasypus* (22, 23), but in another specimen described by Wood (Journ. of Anat. & Phys. i. p. 51), and in Cuvier and Laurillard's specimen (25), the longus only was found. In *Tatusia* the longus and brevis were present in one specimen (25), the longus only in another (26). In *Chlamydochorus* the muscle was totally absent in Hyrtl's specimen (28), whilst in Macalister's (27) the brevis was present. In the *Manidae* the muscle was totally absent in five specimens (29, 30, 31, 32, 34), but in one (33) the longus occurred. In *Orycteropus* (35, 36, 37) the longus alone is present. From the above it will be seen that this muscle is very variable in its condition throughout the Order, not alone varying in different genera but in different specimens of the same animal.

Biceps.—Among the *Bradypodidae*, *Bradypus* is remarkable for possessing a humeral head. This was noticed in five specimens (1, 2, 3, 4, 5), and is described under that name by all five observers individually. In all these cases the head was large, and in all the insertion of the muscle was much blended with that of the brachialis anticus. We must confess that we find it very difficult to give any general rule for determining when a slip coming from the anterior aspect of the humerus and more or less connected with both brachialis anticus and biceps should be regarded as a brachialis anticus internus and when a humeral head of the biceps. When the connection is only with one muscle, as is sometimes the case, the task is comparatively simple. We are not, in this instance, prepared to take a different line from the above-mentioned writers, and therefore, at least conditionally, adopt their terminology. In all the five animals above alluded to there was also a glenoid head, and one (2) in addition possessed a coracoid head, which went to the fascia on the inner side of the forearm. The combined gleno-humeral muscle may be inserted into the radius or the ulna or both. In *Choloepus* (8, 10) only the glenoid head is present, and is inserted partly into the radius partly into the ulna. In one specimen (8) part of the muscle joined the acromial deltoid. In the *Myrmecophagidae*, *Myrmecophaga* (11) has glenoid and coracoid heads, the latter rising from the position which would be occupied by the coracoid process were it present; the glenoid or long head divides below, the more superficial fibres being inserted into the radius with the short head, whilst the deeper group join the brachialis anticus to be inserted into the ulna. The description which we have of the other two specimens (12, 13) seems to agree fairly accurately with the above. *Tamandua* (14, 15, 16) resembles *Myrmecophaga*, though Rapp describes a humeral head in addition, which we believe, in this case, is a part of the brachialis anticus. In *Cyclothurus* (17, 18, 19, 20, 21) only the glenoid origin is present and inserted into the radius and ulna, usually with the brachialis anticus. In the *Dasypodidae* two heads were present in four specimens (22, 23, 24, and an extra specimen) out of five recorded. In *Tatusia* (25, 26) and *Chlamydophorus* (27) only the long head is present. In the *Manidae* the gleno-ulnar part of the muscle alone is present (29, 30, 31, 32, 33, 34). In *Orycteropus* (35, 36, 37) the long head appears to be the only part represented.

Brachialis anticus.—In the *Bradypodidae* the outer part of the muscle alone is usually present, and does not in all cases reach as high as the surgical neck of the humerus. It may or may not join the biceps before its insertion, which is into the radius or ulna or both. In our specimen of *Bradypus* (1) there was also an inner head, which was almost continuous with the coraco-brachialis. In the *Myrmecophagidae* the muscle is remarkable for its frequent fusion with the biceps. We can definitely state that in this family the generalized mammalian brachialis anticus rising from the back of the surgical neck of the humerus and winding round

the outer side of that bone is not present. In *Myrmecophaga* the humeral head of the biceps, already described, may with considerable probability be looked upon as a suppressed and modified brachialis anticus (11, 12, 13). In *Tamandua* (14, 15) the condition is practically the same. In *Cyclothurus* (17, 18, 19, 20) the muscle rises below the deltoid ridge. In the *Dasypodidæ* the external part of the muscle is present and rises from the neck of the humerus in the usual mammalian manner. This applies to *Dasyppus* (22, 23), *Tatusia* (25), and *Chlamydochorus* (27). In the *Manidæ* the outer or long head was found, as in the last-mentioned family, in every case (29, 30, 31, 32, 33, 34). In only one case was the internal head found (29), and in that it rose from the front of the humerus below the deltoid ridge. In two cases (30, 31) this head was carefully looked for, but without success; it is, however, frequently so closely fused with the external head that, unless specially sought for, it is very easily overlooked. In *Orycteropus* (35, 36) the external head was present as usual, but the internal head was present, as a few fibres rising from below the deltoid ridge, in one specimen only (35).

Triceps and Anconeus.—In the *Bradypodidæ*, *Bradypus* (1, 2, 3, 4, 5) and *Choloepus* (8, 10) have the usual three heads, and the inner of these tends to fuse with the anconeus. In the *Myrmecophagidæ* the muscle is often very specialized. Pouchet (II.) describes six heads, three superficial and three deep. The three superficial he calls: (a) "La longue," which is equivalent to our longus, though a few of its fibres rise from the dorsum scapulæ and remind us of the arrangement found in some of the Mustelidæ amongst the Carnivora (Proc. Zool. Soc. 1897, p. 394). This arrangement was also found in the R.C.S. specimen (11). (b) "L'accessoire interne," which we have already alluded to as a displaced latissimo-olecranalis. (c) "L'accessoire externe," which rises by tendon between the two parts of the deltoid and becomes fleshy as it descends. It was not present in the specimen which we examined from the R.C.S. The three deep heads of Pouchet are: (d) "Le vaste interne," (e) "Le vaste externe," and (f) "L'accessoire médian." The two former are simply the usual external and internal heads of the muscle, while the third consists of some fibres from the short head of the biceps to the triceps, which we did not find in the R.C.S. specimen. Macalister (13) points out that the internal head becomes tendinous and passes through a groove behind the internal condyle, through which it plays as through a pulley, its tendon then becoming continuous with one of the heads of the flexor of the digits. This remarkable arrangement, also met with in *Orycteropus*, must, as Macalister remarks, give great additional power to the latter muscle and is a further example of the unusual confluence of usually separate muscles in this Order. In *Tamandua* (14, 15) the long head is very large, rising from all that part of the dorsum scapulæ below the inferior spine which is not occupied by the teres major. In one case (15) an additional

scapular head is noted as rising from just below the glenoid cavity. The fibres of the inner head have the same pulley-like arrangement as in *Myrmecophaga*, as shown by Cuvier and Laurillard's figure (16), and by Rapp's description of them as forming a humeral head for the flexor profundus digitorum (III.). Of the five specimens of *Cyclothurus* of which we have records, three had only one scapular head (17, 18, 21), whilst in two (19, 20) this was double. In one of the first-named group (21) a continuation of the muscle into the forearm, as in *Tamandua* and *Myrmecophaga*, was present. In all the *Myrmecophagidae* the anconeus is large, and especially so in *Cyclothurus*. The *Dasypodidae* resemble the last family in having, as a rule, two scapular heads, which may be called anterior and posterior. The anterior rises from the axillary border below the glenoid cavity, and the posterior from the dorsum scapulae in the region of the lower spine. This applies to *Dasypus* (22), *Tatusia* (25), and *Chlamydophorus* (27, 28). In Galton's specimen of *Dasypus* (23) the long head was apparently single, while in one specimen of *Chlamydophorus* (27) there was a third scapular head from the inferior margin of the bone. In the *Manidae* the scapular head is also usually double, this condition having been noticed in three cases (29, 31, 34); in two cases (32, 33) no division was seen. In *Orycteropus* multiple scapular heads seem to be the rule. In 36 there are three, viz. (a) glenoid, (b) from the posterior costa, (c) from the angle, passing to the triceps and the latissimo-olecranalis. In (35) only two were noticed, but one of them seems as if it would be more properly described as a scapular origin of the latissimo-olecranalis, and the same thing seems to have been present in (31). Macalister (VII.) notices that in a specimen which he dissected the lower fibres of the inner head play round the internal condyle and join the flexor profundus as in the *Myrmecophagidae*. The anconeus presents no special features of interest in the *Manidae* and *Orycteropodidae*. In conclusion, we may point out that all the Edentata, with the exception of the *Bradypodidae*, are remarkable for the great development and complexity of the extensor cubiti and for the presence of additional scapular origins.

Epitrochleo-olecranalis.—We can confirm Galton and Gruber's observations as to the constancy and remarkable development of this muscle throughout the Edentata.

Pronator radii teres rises from the internal condyle and seems to be always inserted into the lower third or half of the radius. This arrangement we find to be so constant that it may be fairly looked upon as an Edentate characteristic.

Flexor carpi radialis.—Unlike most mammals the Edentates show some variability in the insertion of this muscle, though its origin from the internal condyle is constant enough. In the *Bradypodidae* it never seems to obtain its normal insertion into the second metacarpal bone. In four specimens of *Bradypus* (2, 3, 5, 6) it was inserted into the rudimentary trapezium. Mackintosh (5) found a small muscle, which he calls flexor carpi radialis profundus, rising from the ulna and running down to the deep

fascia of the wrist. In three specimens of *Choloepus* (8, 9, 10) the muscle was inserted into the scaphoid. In the *Myrmecophagidæ* the insertion was into the second metacarpal in *Myrmecophaga* (11, 13), *Tamandua* (14), and *Cyclothurus* (17, 18), but in another specimen of *Myrmecophaga* it was into the third metacarpal. Among the *Dasypodidæ* the insertion was into the trapezium in *Dasyppus* (22, 23), but in *Tatusia* (25) and *Chlamyphorus* (27) into the first metacarpal bone. In the *Manidæ* the insertion varies. In four specimens of *Manis* (29, 30, 31, 32) the muscle passed to the second metacarpal only, but in two others (32, 34) slips were given to the three radial metacarpals. In *Orycteropus* (35, 36) the insertion was into the second metacarpal, but a sesamoid bone was apparently developed in the tendon, a portion of which was attached to the styloid process of the radius. In 37 it was also inserted into the second metacarpal.

Palmaris longus.—In six specimens of *Bradypus* (1, 2, 3, 4, 5, 6) this muscle was present, rising from the internal condyle and gaining an insertion into the palmar fascia by one or more of the bony prominences about the palm. In three specimens of *Choloepus* (8, 9, 10) the muscle was also present. In the *Myrmecophagidæ* it is difficult to determine what is palmaris longus and what flexor sublimis digitorum. A careful comparison of the descriptions given by Macalister (13) and Pouchet (12) with the College of Surgeons' specimen (11) makes us inclined to believe that in *Myrmecophaga* the palmaris longus is absent. In *Tamandua* (14, 16) the muscle extends from the internal condyle to the fibro-cartilaginous anterior annular ligament. In *Dasyppus* (22, 23) some superficial fibres of the flexor sublimis passed to the annular ligament, representing, we think, a palmaris longus, but in another specimen (24) the muscle is absent. In *Manis* the muscle may extend from the condyle and olecranon process to the palmar fascia (29, 31, 33) or it may be fused with the flexor sublimis (30, 32, 34). In *Orycteropus* the muscle is either fused with the flexor sublimis (35, 36) or is absent (37).

Flexor sublimis digitorum.—In *Bradypus* this muscle is always absent (1, 2, 3, 4, 5, 6). In *Choloepus* it is present and has two delicate tendons (8, 9, 10), which are more or less connected above with the palmaris longus. In *Myrmecophaga* (11, 12, 13) and *Tamandua* (14, 15, 16) it rises from the internal condyle as well as the olecranon process and some of the shaft of the ulna below it. It is inserted into the middle phalanx of the medius, splitting to enclose the flexor profundus tendon, but not showing the ring which is so evident in Rodents, Insectivores, and Carnivores. In *Dasyppus* the muscle gives tendons to the index and medius (23, 24) or to the medius only (22). In the *Manidæ* the arrangement of this muscle is very inconstant and various writers seem to have confounded it with the palmaris longus. In the two specimens (29, 30) which we dissected the arrangement was quite different. In 32 there was a slip for the pollex from the fascia of the lower part of the forearm, condylar slips for the index and medius, while

the annularis and minimus were supplied by slips from the olecranon and the surface of the flexor profundus. We are, however, not sure whether some of these factors should not rather be referred to the palmaris longus. In 30 the flexor sublimis passed from the condyle to the medius only; before being perforated by the profundus in the theca it had the usual ring passing deep to that tendon. In (29) and (31) no flexor sublimis was seen. Of the other specimens, (34) had also a slip for each digit, whilst (33) resembled (29) and (31) in having no sublimis at all. In *Orycteropus* (35, 36, 37) there were in each case four tendons for the four digits.

Flexor carpi ulnaris.—As usual, this muscle rises from the internal condyle, olecranon, and margin of the ulna. The condylar and olecranal heads unite in the forearm to be inserted into the pisiform. In *Bradypus* (1, 3, 5) the tendon, instead of ending in the pisiform, was inserted into the base of the most ulnar of the three metacarpals. In *Cyclothurus* (13) the muscle is very large and important in function; the pisiform, a fact no doubt correlated with that just mentioned, is also very large.

Flexor profundus digitorum.—In the *Bradypodide*, *Bradypus* (1, 2, 3, 5) has radial, ulnar, and condylo-ulnar heads and divides into three tendons for the three digits. In our own specimen of *Choloepus* (8), radial, ulnar, condylo-central, and condylo-ulnar heads were present, and this seems also to have been the condition in 9 and 10. The muscle ends in two strong tendons. In the *Myrmecophagide*, *Myrmecophaga* has a head continuous with the lower part of the triceps and already described in connection with that muscle. In addition to this it possesses radial, ulnar, and condylar heads. It is a very large muscle and has a variable insertion. In Pouchet's specimen (12) a slip was given to the pollex, but in that at the R.C.S. there were only three tendons, neither pollex nor minimus receiving one. In one specimen of *Tamandua* (15) a humeral head was present, but we failed to find it in our specimen (14). In this instance, however, the factors were much united, and we with difficulty identified radial, ulnar, condylo-ulnar, and condylo-central portions. In one specimen (15) the tendons passed to all five digits, whilst in the other (14) the pollex was not supplied with one. In *Cyclothurus* (17, 18, 19, 20, 21) we have no records as to which condylar heads are present, but the muscle only possesses two tendons, which pass to the second and third digits respectively. In *Dasypus* (22, 23, 24), *Tatusia* (25, 26), and *Chlamydephorus* (27) the muscle is very large, the ulnar portion being specially well developed. In all these animals a strong fibro-cartilaginous sesamoid is developed in the palmar part of the tendon before its division, beyond which slips are given off to all the five digits. In two specimens of *Manis* (30, 32) there were condylo-ulnar, radial, and ulnar heads present. In another (29) the condylo-centralis was present in addition. A palmar sesamoid is present as in the Armadillos, but not to such a marked extent. There may or may not be a small

tendon to the rudimentary pollex. *Orycteropus* (35, 37) has condylo-ular and central parts, also radial and ulnar. The common tendon, which possesses no sesamoid, gives off four tendons.

Lumbricales.—Amongst the *Bradypodidae*, *Bradypus* (1, 2, 3) is devoid of any of these muscles, but *Choloepus* (9) has two, one for each digit. In the *Myrmecophagidae* two specimens of *Myrmecophaga* (11, 12) had four muscles, whilst another (13) had only two. *Tamandua* (14) had three, that for the index being absent, but in another specimen (16) there were six. In *Cyclothurus* two specimens (18, 20) had two lumbricales, whilst another (17) had none at all. *Dasyypus* (22, 23, 24) possessed none at all. In *Chlamyphorus* Hyrtl (28) failed to find any; but in another specimen (27) seven slender fleshy bundles are described as rising from the sesamoid cartilage in the flexor tendon, which are inserted into each side of the middle phalanges of all the digits except the pollex. In *Manis* the number is very variable; there were three in (30), four in (32) and (34), and two in (33). In all the specimens of *Orycteropus* of which we have records (35, 36, 37) there were four.

Pronator quadratus.—Amongst the *Bradypodidae* this muscle is very small, both in *Bradypus* (1, 2, 3, 5) and *Choloepus* (8, 9, 10), occupying in the former only one-eighth to one-sixth of the forearm. The *Myrmecophagidae*, viz. *Myrmecophaga* (12, 13), *Tamandua* (14), and *Cyclothurus* (17, 18, 20), have the muscle extending over the whole length of the interosseous space. In *Myrmecophaga* (12), Pouchet notices that the lower third of the muscle corresponds to the human pronator quadratus in being attached to the surfaces of the radius and ulna, whilst the upper two-thirds is attached only to the opposed margins of the bones. In the *Dasypodidae* and *Manidae* the muscle is usually absent, this being the case in *Dasyypus* (22, 23), *Chlamyphorus* (28), and *Manis* (29, 30, 31, 32, 33, 34). In *Tatusia* (25, 26) it was extremely rudimentary, and in one specimen of *Chlamyphorus* (27) it was represented by a feeble fibrous cord. In *Orycteropus* (35) it occupied the whole length of the bones, as was the case in the *Myrmecophagidae*, though Humphry describes it as being small.

Supinator longus.—This muscle is always present in the *Bradypodidae* and is often double. Of four specimens of *Bradypus*, three (2, 4, 5) had the muscle delaminated into a superficial and a deep layer, both of which arose from the supracondylar ridge, the more superficial being inserted lower down than its deeper fellow. In the other three specimens (1, 3, 6) the muscle was single and rose from the lower half of the humerus. In the last of these (6) the supinator longus and pronator radii teres joined before their insertion. The bilaminar condition of the supinator longus was found in all three specimens of *Choloepus* of which we have records (8, 9, 10). In 9 the superficial layer was inserted into the fascia over the wrist, the deep into the radius. In the other specimens (8, 10) both parts were attached to the radius. In the *Myrmeco-*

phagidæ the arrangement closely resembles that of the Sloths. Of three specimens of *Myrmecophaga* the muscle was bilaminar in two (12, 13), the superficial part going to the fascia and posterior annular ligament and the deep to the styloid process of the radius. In *Tamandua* (14, 16) and *Cyclothurus* (17, 18, 19, 20, 21) the same condition obtained. It is well figured by Cuvier and Laurillard (plate 237). In the *Dasypodidæ* the supinator longus is absent in *Dasypus* (22, 23, 24), *Tatusia* (25, 26), and *Chlamyphorus* (27, 28). In the *Manidæ* the muscle may be present (32, 33, 34) or absent (29, 30, 31). When it is present it is closely connected at its origin with the deltoid, so much so that by some observers the two muscles have been described as continuous. In *Orycteropus* the muscle is present (35, 36, 37) and rises from a considerable portion of the length of the humerus. It is inserted partly into the radius, partly into the fascia over the tendons.

Extensores carpi radiales longior et brevior.—In the Sloths there are usually two insertions, although the muscular belly is described as single. In three specimens of *Bradypus* (2, 3, 4) the muscle, described as single, ended in two tendons, which were inserted into the radial pair of the three metacarpals; but in our own specimen (i.) the longior was absent and the brevior passed from the external condyle to the middle of the shaft of the central (3rd) metacarpal bone. Mackintosh's specimen (5) appears to have presented an identical arrangement. In three specimens of *Choloepus* (8, 9, 10), in spite of the presence of only two metacarpal bones, both tendons were present, and in our own (8) we noticed that the muscular bellies were separable and that the longior was the smaller of the two. The two tendons were in all three cases inserted into the radial of the two metacarpals. The *Myrmecophagidæ* are remarkable for the suppression of the extensor carpi radialis longior, but the brevior is unusually strong. In *Myrmecophaga* (11, 12, 13), *Tamandua* (14, 15), and *Cyclothurus* (17, 18, 20) only the brevior was present, but in another specimen of the latter animal (19) both muscles were found. In the *Dasypodidæ* both muscles seem to be usually present, though the two bellies are sometimes described as being fused. The *Manidæ* are remarkable for the absence of the longior, this condition being noticed in five specimens (29, 30, 31, 32, 33). In *M. javanica*, however, tendons are described as passing to the second and third metacarpals. In *Orycteropus* the longior seems to have been present in (35) and absent in (36).

Extensor communis digitorum.—This rises as usual from the external condyle and is inserted into a variable number of digits. In *Choloepus* it always passes to the second and third, the only two which are present. In *Bradypus* it may go to all three digits (1, 5, 6), the two outer (3) or the two inner (4). In *Myrmecophaga* all the digits may be provided with tendons (12, 13) or only the third and fourth (11). In *Tamandua* (14, 15) slips go to the medius and annularis only. *Cyclothurus* (17, 18, 19, 20, 21) possesses only a tendon for the medius. *Dasypus* (22, 23, 24),

Tatusia (25, 26), and *Chlamydochorus* (27) have tendons for the index, medius, and annularis. In the *Manidae* a strong tendon passes to the medius, and the annularis and minimus are provided with feeble slips (29, 30, 31, 32, 33, 34). In the *Orycteropodidae* (35, 36, 37) all four digits are provided with tendons.

Extensor minimi digiti.—In the Sloths this muscle is often either replaced by or becomes an extensor brevis digitorum, which rises from the dorsum of the carpus and metacarpus and is inserted into one or more of the few digits. It existed under this condition in two specimens of *Bradypus* (2, 3) out of five examined, and in one specimen of *Choloepus* (9) out of three. In the cases in which an extensor brevis was not present, it was replaced by a normal extensor minimi digiti, which obtained an insertion into the most ulnar digit. In *Myrmecophaga* (11, 12) the muscle in question only went to the fifth digit. In *Tamandua* (14) it was attached to the fourth and fifth digits, and in *Cyclothurus* (19, 20) to the rudiments of the same. *Dasybus* (22, 23) and *Chlamydochorus* (27) had this muscle attached to the fourth and fifth digits, and *Tatusia* to the fifth only. In the *Manidae* (29, 30, 32, 33) the muscle was present, but in our specimen it was inserted into the fifth metacarpal bone instead of into the phalanges. As a double tendon from the extensor communis to minimus is described in (32), it is probable that the condition was the same as has just been mentioned. In *Orycteropus* the extensor minimi digiti is inserted into the minimus and annularis (35, 37) or into the minimus alone (36).

Extensor carpi ulnaris.—There is little variety about this muscle; it is always present and rises from the external condyle and dorsal border of the ulna and is inserted into the base of the most ulnar of the metacarpals present.

Extensor ossis metacarpi pollicis.—In the *Bradypodidae* both *Bradypus* (1, 2, 3) and *Choloepus* (8, 9, 10) have this muscle inserted into the trapezium, though in Mackintosh's specimen (5) the insertion is said to have been into the base of the inner metacarpal. In the *Myrmecophagidae* the muscle appears to be always present, but in *Cyclothurus* (17, 18) it is said to rise from the external condyle. In the *Dasypodidae* it is present and extends from the ulna to the first metacarpal. In the *Manidae* it sometimes is inserted into the first metacarpal, sometimes into the trapezium. In *Orycteropus* (35, 36) it is inserted into the dorsum of the trapezium.

Extensor profundus digitorum.—In *Bradypus* (1, 2, 3, 4, 5, 6) an extensor indicis, which passes to the most radial of the three digits, is always present. In *Choloepus* (8, 9, 10) the extensor profundus always gives a slip to the radial of the two digits and sometimes (9, 10) to the ulnar one also. In *Myrmecophaga* (11, 12, 13) there are slips from the deep extensor to the pollex and index. In *Tamandua* (14, 15) there is, in addition, a slip to the medius. In *Cyclothurus* (17, 18, 19, 20) there is always a tendon to the third digit (medius) and sometimes one to the rudimentary

index as well. In *Dasyppus* (22, 23) there are tendons for the index and pollex, but in (24) for the index only.

In *Tatusia* there are tendons for the index and medius in (25) and for index only in (26). In *Chlamydophorus* (27) the tendon to the index gives a fascial slip to the pollex. In *Manis* (29, 32, 33) the extensor indicis alone is present, but in one case (30) there is a polliceal slip as well. *Orycteropus* has a well-developed extensor profundus, which in two cases (35, 36) went to the index, medius, and annularis, and in another (37) to the index and medius only. It is interesting to notice that whilst in some of these animals the origin is as usual from the dorsal surface of the ulna, in others it seems to have slipped down and the muscle rises from the dorsum of the carpus and closely corresponds to the extensor brevis digitorum pedis. This low origin was found in the following animals: *Bradypus* (1, 4, 5), *Choloepus* (10), *Cyclothurus* (17), *Manis* (30, 33).

Pulmaris brevis.—This muscle was well marked in *Bradypus* (1), *Tamandua* (14), and *Cyclothurus* (18). In *Tamandua* it was a peculiarly large muscle, filling the great boxing-glove like pad on the ulnar side of the hand. In *Myrmecophaga* it was very feeble, if, indeed, it was present at all, whilst we failed to find any trace of it in any other Edentate.

Supinator brevis.—In the *Bradypodidae* this muscle covers the upper third of the radius. In two specimens of *Choloepus* (8, 10) it was divided into two layers, between which lay the posterior interosseous nerve, but in another specimen of the same animal (9) this division was not noticed. In the *Myrmecophagidae* the muscle is inserted into the lower part of the radius—*Myrmecophaga* (11, 12), *Tamandua* (14), and *Cyclothurus* (17, 18, 19, 20). Among the *Dasypodidae* the muscle is small in *Dasyppus* (22, 23), small or absent in *Tatusia* (25, 26) and *Chlamydophorus* (27, 28). In the *Manidae*, on the other hand, it is inserted into nearly the whole length of the radius (29, 31, 32, 33, 34), and has a sesamoid bone developed in its origin. In *Orycteropus* (35, 36) the muscle only occupies the upper half of the radius.

Intrinsic Muscles of the Hand.—We find it extremely difficult, in reading the literature of the subject, to understand at what depth the various muscles were placed and to which digit precisely they were attached. As it has been always our desire to err less on the side of commission than of omission, we feel bound to omit much which did not appear clear to us, and must therefore confess that our account of these muscles in the Edentata is somewhat of the scantiest. In *Bradypus* (1) there was an adductor pollicis and also adductors of the index and annularis, which were superficial to the deep branch of the ulnar nerve. An interosseous muscle is present between each of the metacarpal bones. In *Choloepus* (8) there is an adductor indicis, belonging to the first layer of deep muscles, which rose from the carpus and was inserted into the ulnar side of the base of the proximal phalanx of the index; there is also an interosseous muscle on each side of the index. In the

specimen of *Myrmecophaga* which we examined (11) there was a well-marked flexor brevis digitorum manus, which rose from the anterior annular ligament and was inserted into the middle phalanges of the annularis and minimus. The same muscle with the same attachments was evidently present in Pouchet's specimen (12). An adductor pollicis was met with in this specimen, arising from the base of the second metacarpal, and was also present in (11) and (13). In all three specimens an abductor minimi digiti, arising from the pisiform, was also present. The dorsal interossei were arranged as in Man. We were unable to examine the palmar interossei in our specimen, but in that described by Macalister (13) there were apparently two, belonging to the index and annularis respectively. In *Tamandua* (14) there were superficial adductors to the index, medius, and annularis, and a pair of flexores breves to each functional digit. There were also abductor and flexor brevis pollicis. In *Dasypus* (22) there is an abductor and flexor brevis pollicis, an abductor minimi digiti, and a transverse adductor indicis arising from the heads of the metacarpals of the annularis and minimus. Interossei are inserted into the radial side of the index and medius, and others are represented by fibrous bands. In *Manis* (30) there were superficial adductors from the bases of the palmar side of the metacarpals to the index and minimus. There were also four dorsal interossei arranged as in Man, but no palmar interossei were present. In *Orycteropus* (35, 36) there appear to have been superficial adductors for the index and minimus, an abductor minimi digiti, and paired flexores breves to all four digits.

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4. Additions to the Knowledge of the Phytophagous Coleoptera of Africa.—Part II.¹ By MARTIN JACOBY, F.E.S.

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(Plate XXI.)

This paper forms the second part of that read before the Society last year. It deals with the species of the subfamilies *Halticinae* and *Galerucinae* of different parts of Africa, so far as I have been able to determine them at present. Most of the material was received from Mr. Guy Marshall, the indefatigable collector in Mashonaland, to whose labour we are indebted for so many novelties. In a future Supplement I hope to deal with the rest of the species received since.

HALTICINÆ.

PHYGASIA SULPHURIPENNIS, sp. n.

Entirely pale flavous, the antennæ robust, the thorax impunctate, with deep transverse sulcus; elytra extremely minutely and closely punctured.

Length 5 millim.

Head impunctate, frontal elevations and the clypeus broad, palpi robust; antennæ not extending to the middle of the elytra, flavous, the joints robust, the third and following ones of nearly equal length, the second, small and round; thorax about one-half broader than long, the sides rounded at the middle, the anterior angles blunt, the posterior ones distinct, the surface not perceptibly punctured, the basal sulcus deep, bounded at the sides by a perpendicular groove; elytra microscopically punctured, convex, their epipleuræ very broad and concave; metatarsus of the posterior

¹ For Part I. see P. Z. S. 1898, p. 212.